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INTRODUCTION.

This REVIEW is based on reports for July, 1893, from 3,126 regular and voluntary observers. These reports are classified as follows: 163 reports from Weather Bureau stations; 44 reports from United States Army post surgeons; 2,113 monthly reports from state weather service and voluntary observers; 31 reports from Canadian stations; 210 reports through the Southern Pacific Railway Company; 565 marine reports through the co-operation of the Hydrographic Office, Navy Department; marine reports through the "New York Herald Weather Service"; monthly reports from local services established in all states and territories; and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

CHARACTERISTICS OF THE WEATHER FOR JULY, 1893.

The month was cooler than usual over the interior of the middle Atlantic and New England states, over the Florida Peninsula, from the west Gulf coast to the lower Missouri valley, and from the Pacific coast over west portions of the plateau region. In the Ohio and middle and upper Mississippi valleys and the central and western lake region and thence to the south Atlantic coast, over the interior of Texas and thence to the middle Missouri valley, and from the northeast slope of the Rocky Mountains to Manitoba, the month was warmer than the average July. At stations in the Carolinas, Kentucky, and central Texas the month was the warmest July on record. Light frost was reported in northern New England on the 10th, 12th, and 22d, in western New York on the 24th and 28th, in southwestern Lower Michigan and northeastern Indiana on the 4th, and in the northern Rocky Mountain region on the 7th, 12th, and 14th.

PRECIPITATION.

The month was exceptionally dry over the greater part of the country. At stations in New England, eastern New York, North Carolina, the upper Ohio valley, south-central Tennessee, Nebraska, and on the north Pacific coast, the monthly rainfall was the least on record for July. In parts of Virginia, Alabama, and the Lake Michigan and Lake Superior regions, in the Saskatchewan Valley, and from the Missouri Valley over New Mexico, the monthly precipitation was in excess of the July average. Snow was reported at Pikes Peak, Colo., on the 2d, 25th, 26th, and 28th to 30th. The total snowfall at that station was 3.0 inches. Trace of snow was reported at Breckenridge, Colo., on the 13th, and trace was noted at Bonanza City, Idaho, on the 6th.

LOCAL STORMS.

The most disastrous storm of the month swept eastward over Cherokee, Buena Vista, and Pocahontas counties, Iowa, the evening of the 6th, killing upwards of 50 persons, and destroying property valued at about $200,000. Warning of the probable occurrence of severe local storms was telegraphed from the Weather Bureau at Washington to points throughout Iowa at 11.08 p. m. of July 5th, eighteen hours before the development of the storm above referred to.

DROUGHT.

Damaging drought prevailed in parts of the middle Atlantic and New England states, North Carolina, eastern Florida, Alabama, the Ohio Valley and Tennessee, southeastern Missouri, Arkansas, central Texas, southern Kansas, western Nebraska, southwestern South Dakota, Utah, and Idaho.

AURORAS.

The night of the 15th auroral displays were noted generally over northern and north-central portions of the country from the New England to the north Pacific coasts.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for July, 1893, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on Chart II by isobars.

Chart V exhibits the normal distribution of atmospheric pressure and prevailing wind-directions over the United States for July. The publication of the charts of this series is preliminary to the publication by the Weather Bureau of specially prepared data and charts showing meteorological and climatic features and conditions of the United States.

In July there is usually an increase of pressure, except over extreme northeast and northwest portions of the country, the most marked increase occurring between the Mississippi River and the Rocky Mountains, where the normal pressure is .05 or more higher than for the preceding month.

In July, 1893, the mean pressure was highest over the east Gulf states and the Florida Peninsula and along the immediate Pacific coast north of the 40th parallel, where it was above 30.05, and the mean readings were above 30.00 south of the Ohio River and east of Oklahoma and Texas. The mean pressure was lowest over the Gulf of Saint Lawrence and the upper Saskatchewan valley and over the west part of the southern plateau region, where it was below 29.80, and the mean values were below 29.85 over northern Maine and on the northeast slope of the Rocky Mountains. The mean pressure was also below 29.85 from the western portion of the southern plateau region over Utah and Nevada.

A comparison of the pressure chart for July, 1893, with that of the preceding month shows a decrease of pressure over the middle Atlantic and New England states, the Canadian Maritime Provinces, the eastern lake region, and from the Pacific coast over the northern Rocky Mountain region. Over interior and southern districts the mean pressure was higher than for the preceding month. The most marked decrease of pressure occurred over the Canadian Maritime Provinces, where the mean values were .15 to .20 lower than for the preceding month. Along the middle Pacific coast and over a part of the northern Rocky Mountain region the decrease was about .05. The greatest increase of mean pressure was shown on the west Gulf coast and at Fort Stanton, N. Mex., where it was .10. Over the middle and west Gulf states, the southern Rocky Mountain region, east parts of the middle and southern plateau regions, and in the extreme northwest the mean pressure was about .05 higher than for June, 1893.

The departures from the normal pressure were small, except over eastern New England, the Canadian Maritime Provinces, on the northeast slope of the Rocky Mountains, and in the lower Colorado valley, where the mean readings were .05 or more below the normal. In the middle and lower Mississippi valleys, over the west Gulf states, and on the north Pacific coast the mean pressure was somewhat above the normal, the greatest departure, .05, being noted at Fort Smith, Ark.

HIGH AND LOW AREAS.

The paths of areas of high and low barometric pressure traced over the United States and Canada during July, 1893, are shown on Charts IV and I, respectively, and some of the more prominent characteristics of the high and low areas are given in the table at the end of this chapter.

HIGH AREAS.

Five high areas appeared, the average number traced for July during the last 19 years being 5.7. Two of the high areas traced for the current month advanced from the north Pacific coast, 2 appeared over the Dakotas, and 1 moved southeastward from the British Northwest Territory. The high areas from the north Pacific and those that appeared over the Dakotas passed off the Atlantic coast south of the 40th parallel. The high area from the British Northwest Territory occupied the lower Missouri valley at the close of the month. The following is a description of the high areas traced:

I.—Apparently developed on the northeast slope of the Rocky Mountains, and the morning of the 2d covered the middle and upper Missouri valleys and the middle-eastern slope of the Rocky Mountains. During the 3d this high area drifted eastward over the central valleys, and during the 4th passed off the south Atlantic coast.

II.—The pressure continued high on the north Pacific coast from the 2d to the 6th. During the 7th this high area moved eastward over the northern Rocky Mountain region, attended by light frost in eastern Washington, eastern Oregon, Idaho, and northern Nevada. Moving rapidly southeastward the high area reached the middle Missouri valley by the evening of the 8th. The morning of the 9th a temperature fall of 20° was shown over eastern Ontario, the pressure was high from Manitoba to Texas, and two areas of higher pressure appeared, one over Manitoba and the other over Iowa. By the morning of the 10th the pressure was highest over Wisconsin. During that date the high area moved eastward and occupied the southern lake region and the middle Atlantic states. During the 11th the high area moved off the middle Atlantic coast, with pressure above 30.20.

III—Apparently developed over the Red River of the North Valley during the 17th, and during the 18th moved eastward over the extreme upper Mississippi valley. During the 19th and 20th this high area remained nearly stationary over the Lake region, with pressure rising above 30.20 at the morning report of the 20th. By the evening of the 21st the center had shifted position southwestward to Missouri, and during the 22d passed to the west Gulf states. The high area occupied the Gulf of Mexico on the 23d, and during the 24th moved rapidly northeastward and united on the middle Atlantic coast with high area III *a*, which had advanced southeastward from the northern lake region. The morning of the 24th light frost was reported in southwestern New York.

IV.—Advanced from the north Pacific coast and the morning of the 25th occupied Alberta, with pressure above 30.20. By the evening of the 25th this high area had moved eastward over the Saskatchewan Valley, and the temperature had fallen 26° at Lander, Wyo. During the 26th the high area passed southeastward to Iowa, and the temperature fell 20°, or more, over parts of Kansas and Nebraska. Passing eastward over the southern lake region during the 27th, this high area moved thence southeastward off the middle Atlantic coast during the 28th, with pressure rising above 30.20.

V.—Appeared north of Montana the morning of the 30th. The evening of that date the pressure was high from the eastern Saskatchewan valley to New Mexico, with highest pressure over the middle Rocky Mountain region. The morning of the 31st the pressure was above 30.20 in an area extending from eastern Colorado to central South Dakota. At the close of the month an extensive area of high pressure covered Minnesota and the Dakotas, and extended thence over New Mexico and northwestern Texas.

LOW AREAS.

The low areas of July advance eastward over the United States at an average velocity of 25 statute miles per hour. The average velocity of low areas for May, June, and July is the lowest for the year. The low areas of July generally appear on the middle and northeast slopes of the Rocky Mountains and pass over or north of the Lake region and Saint Lawrence Valley to Newfoundland. An average of less than 1 low area per month advances from the north Pacific Ocean and traverses the North American continent in July.

The tracks of 7 areas of low pressure are plotted on Chart I for July, 1893, the average number of low areas traced for July during the last 21 years being 9.5. All of the low areas traced for the current month first appeared over the British Northwest Territory; subsidiary disturbances developed over the middle plateau region and the Dakotas, respectively. Five of the low areas traced passed north of the Gulf of Saint Lawrence, 1 disappeared south of Nova Scotia, and 1 occupied the Saint Lawrence Valley at the close of the month. The following is a description of the low areas traced:

I.—Occupied Manitoba at the opening of the month, with pressure below 29.70, and passed thence to the region north of Lake Superior by the evening report of the 1st, attended by rain in the central valleys and the Lake region, and by thunder and hail storms in the Missouri Valley. During the 2d this low area moved slowly eastward north of the Lake region, rain fell in areas from the lower Missouri valley to the middle and south Atlantic and Gulf coasts, and severe thunderstorms were reported in the Ohio Valley, Lower Michigan, Kansas, and Nebraska. By the evening of the 3d the center of disturbance had reached the Saint Lawrence Valley, the rain area had contracted to the Atlantic coast and Gulf States, and heavy thunderstorms had occurred in New York, Pennsylvania, and Maryland. During the 4th the storm-center disappeared north of the Gulf of Saint Lawrence, rain was followed by clearing weather in New England, and destructive thunderstorms occurred in Maine.

II.—Appeared over Alberta the evening of the 2d, with pressure below 29.60. During the 3d this low area moved

slowly eastward north of Montana and a secondary disturbance appeared over the middle Rocky Mountain region. On that date rain fell in the Missouri Valley, and thunderstorms and high winds occurred in the Dakotas. During the 4th the storm-center advanced to the extreme upper Mississippi valley, and the pressure continued low over the middle Rocky Mountain region, rain fell from the lower Missouri valley over the upper lake region, and destructive local storms were reported in Missouri. Moving rapidly eastward this low area reached the Saint Lawrence Valley by the evening of the 5th, with heavy thunderstorms in the middle Atlantic and south New England states, and during the 6th passed over the ocean south of Nova Scotia, attended in the early morning by thunderstorms in southeastern Massachusetts.

III.—During the eastward advance of low area II the pressure continued low over the middle Rocky Mountain region, and the morning of the 6th low area III appeared north of the Dakotas. During that date this low area moved slowly eastward over Manitoba, with pressure below 29.60, and the pressure decreased rapidly, with abnormally high temperature in the lower Missouri valley. Rain fell throughout the Missouri Valley, and from 5 to 7 p. m. an exceptionally destructive tornado moved eastward over the northwestern counties of Iowa. The morning of the 7th a trough of low pressure extended from the valley of the Red River of the North to northwestern Texas, and by the evening report the northern end of this trough of low pressure had swung eastward over Lake Superior. Rain fell throughout the region of low pressure, and thunderstorms occurred in the upper lake region, Minnesota, Iowa, and the Dakotas. Moving rapidly eastward, the center of disturbance reached the lower Saint Lawrence valley the evening of the 8th, with pressure 29.40, the rain area reached the Atlantic coast, and severe thunderstorms occurred in the Atlantic coast states, the Ohio Valley, and the lower lake region. By the morning of the 9th the storm-center had disappeared over the Gulf of Saint Lawrence, and rain had been followed by clearing weather along the Atlantic coast.

IV.—Appeared over Alberta the evening of the 9th, and during the 10th advanced over Montana. At the evening report of the 10th the pressure was low from the British Northwest Territory to Arizona, and two cyclonic centers appeared, one over eastern Montana and the other over the middle plateau region. On that date rain fell in northern New Mexico and along the eastern Rocky Mountain slope, and at night a severe thunderstorm occurred at Havre, Mont. During the 11th this low area was central over extreme southwestern North Dakota, with pressure 29.50, rain fell in the middle Rocky Mountain region and the Northwest, and thence over the Lake Superior region, and thunderstorms occurred at night in North Dakota and Minnesota. During the 12th the storm-center passed to the region north of the Dakotas, with pressure below 29.30, rain fell in areas in the Lake region and the British Northwest Territory, and thunderstorms were reported in Minnesota and western New York.

During the 13th the pressure decreased from the middle Rocky Mountains over the Dakotas, and this low area remained nearly stationary north of North Dakota. Thunder and rain storms occurred in the middle Missouri valley. The morning of the 14th a secondary disturbance appeared over the eastern Dakotas, and the evening report showed this low area central north of Minnesota. On that date severe thunderstorms occurred in the upper Mississippi and middle Missouri valleys, Wisconsin, and Minnesota. Moving rapidly eastward the storm-center reached the Saint Lawrence Valley the evening of the 15th, attended by rain and severe thunderstorms in the eastern lake region and middle and upper Ohio valleys, and during the 16th passed over the Gulf of Saint Lawrence, with an apparent increase of energy. On the 16th thunder, rain, and wind storms occurred over the eastern lake region, the Ohio Valley, and the middle Atlantic states.

V.—The pressure continued low on the northeast slope of the Rocky Mountains from the 19th to the 23d, and on the latter-named date this low area appeared north of Montana. During the 24th the center of disturbance advanced eastward to Manitoba, with pressure below 29.60 and rain and thunder storms from North Dakota over the Lake Superior region. Moving eastward north of the Lake region during the 25th this low area was attended by rain and thunder storms in the middle and lower Missouri, upper Mississippi, and lower Ohio valleys, and the western lake region. During the 26th the low area advanced to the lower Saint Lawrence valley, with pressure below 29.50, and severe thunderstorms occurred from the Ohio Valley over the middle Atlantic and New England states.

VI.—Appeared north of Montana on the 26th, with pressure below 29.60. The night of the 26th heavy rain fell in the middle Rocky Mountain region, and thunderstorms were reported in Kansas. By the evening of the 27th the storm-center had advanced to Manitoba, with pressure below 29.50. Heavy rain had fallen throughout the Missouri Valley and the middle Rocky Mountain region, and severe thunderstorms

Tabulated statement showing principal characteristics of areas of high and low pressure.

Barometer.	First observed.			Last observed.		Duration.	Velocity per hour.	Maximum pressure change in 12 hours, maximum abnormal temperature change in 12 hours, and maximum wind velocity.									
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.			Station.	Rise.	Date.	Station.	Fall.	Date.	Station.	Direction.	Miles per hour.	Date.
High areas.		°	°	°	°	*Days.*	*Miles.*		*Inch.*			°					
I	2	46	103	34	76	2.5	29	Dodge City, Kans	.22	2	Montgomery, Ala	13	2	Dodge City, Kans	se.	16	2
II	6	47	125	39	77	4.5	26	Concordia, Kans	.38	8	Cheyenne, Wyo	21	7	Chicago, Ill	ne.	20	10
III	17	46	97	40	80	7.0	20	Washington, D.C	.28	24	Portland, Me	14	22	Kearney, Nebr	nw.	30	17
IV	25	51	113	43	81	2.5	30	Calgary, N. W.T	.36	24	Denver, Colo	17	25	Chicago, Ill	se.	16	27
V	30	52	112	41	97	1.5	31	Qu'Appelle, N. W.T	.34	30	Pueblo, Colo	16	30	Amarillo, Tex	nw.	20	31
Mean						3.6	27		.32			16				20	
Low areas.									Fall.			Rise.					
I	1	52	95	49	71	2.5	19	Port Arthur, Ont	.18	1	Little Rock, Ark	11	1	Saint Vincent, Minn	w.	36	1
II	2	52	115	44	62	4.0	28	Calgary, N. W. T	.46	2	Medicine Hat, N. W.T	19	2	Pierre, S. Dak	w.	50	3
III	6	53	102	50	68	2.5	28	Father Point, Que	.44	8	Milwaukee, Wis	19	7	Detroit, Mich *	nw.	54	7
IV	9	51	115	50	67	6.5	21	Medicine Hat, N. W.T	.36	9	Duluth, Minn	24	13	Columbus, Ohio	nw.	59	15
V	23	53	111	50	71	2.5	32	Calgary, N. W.T	.32	23	Marquette, Mich	20	24	Amarillo, Tex	sw.	60	24
VI	26	51	111	49	70	3.0	27	do	.38	26	Qu'Appelle, N. W.T	20	26	Saint Louis, Mo	nw.	50	28
VII	28	51	109	47	72	3.0	25	Swift Current, N. W.T	.42	28	Havre, Mont	24	28	Norfolk, Va	sw.	36	31
Mean						3.4	26		.37			27				49	

* Pikes Peak, Colo., w., 64, 7th.

had occurred in the Dakotas and Kansas. During the 28th the low area passed north of the Lake region with an apparent loss of energy, rain fell in the Lake region and upper Mississippi valley, and destructive wind and thunder storms occurred in Missouri in the evening. During the 29th the center of disturbance advanced to the lower Saint Lawrence valley, and the rain area contracted to the Atlantic coast.

VII.—Appeared north of Montana the evening of the 28th, with pressure below 29.60, and during the 29th moved eastward to Manitoba, with rain and thunder storms in the Missouri Valley. During the 30th this low area advanced to the Lake Superior region without evidence of marked energy. On that date rain and thunder storms were reported from Kansas over the Ohio Valley and the Carolinas. By the close of the month the storm-center had advanced to the middle Saint Lawrence valley, and an area of rain and thunder storms covered the middle and south Atlantic states, Tennessee, and Arkansas.

NORTH ATLANTIC STORMS FOR JULY, 1893.

[*Pressure in inches and millimeters; wind-force by Beaufort scale.*]

The paths of storms that appeared over the west part of the north Atlantic Ocean during July, 1893, are shown on Chart I. These paths have been determined from reports of observations by shipmasters received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Over the north Atlantic Ocean the July normal pressure is highest in an area extending over and southwest of the Azores, where it is above 30.20 (767). The normal values are lowest in an area covering the ocean between Iceland, Greenland, and Spitzbergen, where the normal pressure is below 29.70 (754).

In July there is usually an increase of pressure over the north Atlantic Ocean, except off the middle Atlantic and New England coasts and over eastern and extreme northern portions of the ocean. In regions where the normal pressure is higher than for the preceding month the increase is less than .05 inch. From the British Isles northward the normal readings are .05 to .10 inch higher than for June.

The storms of July advance eastward over the Atlantic Ocean at an average velocity of about 19 statute miles per hour. An average of 1.8 storm per month traverses the ocean from the American to the European coasts. The principal track of July storms is traced from Newfoundland to about north 55°, west 25°, where it divides, one branch passing northeastward to the coast of Norway and the other south of east over the British Isles and the continent of Europe.

Generally fair and settled weather prevailed over the north Atlantic Ocean during July, 1893. Three storms apparently crossed the ocean from coast to coast. One of these storms was central southwest of the Banks of Newfoundland at the opening of the month. During the 2d and 3d this storm moved slowly east-northeastward, and reached mid-ocean north of the 50th parallel on the 4th. Moving thence slowly eastward the storm-center passed north of the British Isles by the 8th. The pressure continued low over the British Isles from the 9th to the 11th, and during the 11th this storm apparently passed eastward over the continent of Europe. The second storm that traversed the ocean appeared off the New England coast on the 13th. By the morning of the 14th this storm had moved south of east to the 60th meridian, with pressure about 29.70 (754), and by the 15th had reached a position south of Newfoundland, with pressure about 29.60 (752). Moving northeastward with a decrease of energy the center of disturbance passed north of the region of observation after the 17th. On that date the storm was joined by low area IV, and reports indicate that the disturbance moved eastward in high latitudes and passed north of the British Isles during the 19th. The third storm that traversed the ocean was the severest of the month. This storm apparently passed eastward from the Gulf of Saint Lawrence on the 19th, reached a position north of the Banks of Newfoundland by the 21st, with pressure below 29.30 (744), increased in energy by the 22d, when the pressure fell below 29.20 (742) and gales of force 11 were reported between the 30th and 40th meridians, and passed thence eastward and disappeared north of the British Isles by the 25th.

A destructive whirlwind, crossed eastern Cuba the evening of the 6th. The storm struck the island at Santiago de Cuba, passed thence north of east to a point west of Baracoa, and there recurved and passed inside the north-northeast coast line to a point west of Banes, where it passed to sea. A schooner was wrecked off Santiago de Cuba, and in the district about Banes 10,000 acres of banana plants and property valued at $200,000 were destroyed. The storm reached Santiago de Cuba at 8.30 p. m. At that place the wind shifted from south-southeast to north-northeast, and blew with great fury. A destructive cyclone visited the Bay Islands, off the north coast of Honduras, Central America, July 6th, wrecking a number of vessels, and causing great loss of life and property.

On the 5th low area I occupied the Gulf of Saint Lawrence, and the morning of the 6th was apparently central between Cape Breton Island and Newfoundland. By the 7th the storm-center had passed southeast of Nova Scotia and had been joined by low area II, which had advanced south of east over Nova Scotia during the 6th. On the 8th this storm occupied the west portion of the Banks of Newfoundland, but possessed small strength, and on the 9th moved slowly northeastward along the east Newfoundland coast, where it was joined by low area III, which had passed eastward over the Saint Lawrence Valley during the 8th. By the morning of the 10th this storm had disappeared north of the Grand Banks. On the 20th a storm occupied the ocean northeast of the Banks of Newfoundland. By the 21st this storm had apparently united with a storm previously referred to as having passed eastward from the Gulf of Saint Lawrence during the 19th. The pressure continued low over Newfoundland and the Grand Banks until the 24th. During the 26th and 27th low area V passed north of east from the Saint Lawrence Valley to Labrador, and by the 27th this storm had disappeared north of the region of observation. Over the British Isles the pressure continued high from the 25th to the close of the month.

OCEAN FOG IN JULY.

The limits of fog-belts west of the 40th meridian, as reported by shipmasters, are shown on Chart I by dotted shading. About the usual amount of fog was reported. Near the Banks of Newfoundland fog was reported on 25 dates; between the 55th and 65th meridians on 17 dates; and west of the 65th meridian on 11 dates. Compared with the corresponding month of the last 5 years, the dates of occurrence of fog east of the 55th meridian numbered 1 less than the average; between the 55th and 65th meridians 2 less than the average; and west of the 65th meridian the same as the average. The fog noted by shipmasters and that reported by